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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/817,334	03/21/2001	James A. Folta	IL-10725	8917

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EXAMINER
GLASS, CHRISTOPHER W

ART UNIT	PAPER NUMBER
2878	

DATE MAILED: 07/17/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/817,334	FOLTA ET AL.	
	Examiner	Art Unit	
	Christopher W. Glass	2878	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 March 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *21 March 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Information Disclosure Statement

1. The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609 A(1) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered.

Drawings

2. Figures 1A and 1B should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

3. The disclosure is objected to because of the following informalities:

The terms "EUVL" (appearing on line 7 of page 6) and "PSDI" (appearing on line 3 of page 8) should be defined.

On line 7 of page 11, it appears that "imbed" should replace "embed"; Also, on line 11, "that a" should read "in which".

The description contained in lines 10-21 of page 12 should be moved to the "BACKGROUND OF THE INVENTION" section.

On line 20 of page 3, "accomplished an electron" should read "accomplished through an electron".

Appropriate correction is required.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1,2,5,6,11,18, and 19 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 6,010,538 to Sun et al (Sun).

Regarding claims 1 and 19: Sun discloses a conventional method for correcting the figure of a substrate 53 (see Figure 6A), comprising measuring the figure of a surface 48 of the substrate, applying a figure-correcting layer 50 to a surface of the substrate and locally adjusting the thickness of the figure-correcting layer (see Column 1, lines 34-41), and measuring the thickness of the figure-correcting layer at a plurality of points (see Column 1, line 58 – Column 2, line 4).

Regarding claim 2: The method taught by Sun also discloses iterating between the steps of locally adjusting the thickness of the figure-correcting layer 50 and measuring the thickness of the figure-correcting layer until a desired figure is obtained (see Column 1, line 61 – Column 2, line 2).

Regarding claims 5 and 11: The disclosure of Sun teaches measuring the figure (e.g. layer 48) of a substrate 53 through the use of interferometry (see Column 1, line 64 – Column 2,

line 2), and Figure 6A shows the implementation of correction methods, including measuring "the amount that the layer 48 has been reduced in thickness" by determining "the number of cycles (FIG. 8A) that the detected interference response has undergone during the CMP process" wherein "the sensor unit 24c (see Figure 4) detects an interference between the reflections from the two surfaces of the layer 48" (Column 8, lines 13-16; Column 7, lines 65-66).

Regarding claim 6: The thickness of the figure-correcting slurry layer (e.g. slurry layer 50 of Figure 6B) is known (see Figure 6 descriptions of Columns 7 and 8, and conventional chemical mechanical polishing (CMP) process description in Column 1, lines 34-47).

Regarding claims 18 and 19: Sun teaches locally adjusting the thickness of the figure-correcting layer 50 (and substrate top layer 48) through the use of a polishing tool (Column 1, lines 41-47).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 3,4,7,8,14-17,21-28, and 31-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sun.

Regarding claims 3 and 7: The figure-correcting layer of Sun (chemical slurry) comprises "both abrasive particles...and reactive chemicals", but it is not specifically cited as comprising an index of refraction that is nearly the same as or different from the index of refraction of the substrate. However, it would have been obvious to one having ordinary skill in the art at the

time the invention was made to use a figure-correcting layer having these characteristics, in order to prevent undesired optical interference or false measurement signals when obtaining figure measurements. Further, it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

Regarding claim 4: In the procedure of Sun, "a pronounced shift in reflected light intensity often occurs when the film has been completely removed" or "by analyzing the pattern of peaks and valleys" generated by optical interference, "one can determine the amount of film that has been removed" (Column 1, line 63; Column 2, line 2). While the method of Sun does not expressly disclose applying a marker layer to the substrate before applying the figure-correcting slurry layer, the technique discussed by Sun is functionally equivalent, in terms of locating via optical processes and assessing the thickness of the thin film located on the substrate and therefore the effective figure of the substrate. It therefore would have been obvious to one having ordinary skill in the art at the time the invention was made to have implemented this technique rather than applying a separate marker layer before applying the figure-correcting layer.

Regarding claim 8: The figure-correcting layer (slurry **50**) of Sun is not specifically cited as comprising an optical material having embedded material selected from the group consisting of Al, Cr, Co, Ni, Ti, Mo, and Si. However, Sun discusses a conventional CMP process as employing "abrasive particles (to accomplish the mechanical grinding) and reactive chemicals (to assist the film removal by chemical modification of the film surface)" within the slurry. Therefore, it would have been obvious to one having ordinary skill in the art to have embedded

such materials in the figure-correcting layer, since these elements could provide advantageous properties of mechanical grinding and offer chemical reactions to correct the figure of the substrate. Further, it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

Regarding claims 14-17 and 31-32: The method of Sun, or the modified method of Sun, does not specifically teach comparing the thickness of the figure-correcting layer 50 to the figure of the surface (e.g. 48, Figure 6A) of the substrate 53 to determine the figure of the substrate in combination with the figure-correcting layer. Also, Sun does not expressly disclose locally adjusting the thickness of the figure-correcting layer by adding material, removing material, or a combination of adding and removing material to and from, respectively, the figure-correcting layer 50. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to calculate and use an optimal amount of figure-correcting material to affect the figure of the substrate 48,53, through adding and/or removing, since excess or insufficient amounts of figure-correcting material would fail to adequately adjust the substrate figure.

Regarding claims 21 and 22: The method of Sun measures the figure of the surface while simultaneously applying the figure-correcting layer (see Column 1, line 48 - Column 2, line 4), and therefore the measuring step does not occur prior to or after the step of applying the figure-correcting layer. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to implement these procedures in a sequence, in order for the

status of the figure (i.e. thickness, etc.) to be verified and evaluated between each period of adjustment.

Regarding claims 23-26: Sun teaches a conventional method of correcting the figure of a substrate (Column 1, line 34 – Column 2, line 2), comprising applying, locally-adjusting, and measuring a figure-correcting layer (e.g. 50, Figure 6A), measuring the figure of the substrate before and after the adjustment, and iterating between measurement and adjustment. The figure-correcting layer of Sun is not specifically cited as comprising more than one layer, thus providing an interface layer in addition to the figure-correcting layer. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to provide a figure-correcting layer and a supplemental interface layer having the same preferred material, or a different material composition as the slurry/figure-correcting material 50, in order to create buffer layers to change the thickness of the substrate layers or to inhibit excessive removal of figure layers.

Regarding claim 27 and 28: The figure-correcting layer of the modified method of Sun (chemical slurry) comprises "both abrasive particles...and reactive chemicals", but it is not specifically cited as comprising an index of refraction that is nearly the same as or different from the index of refraction of the substrate. Also, the modified means of Sun does not expressly disclose applying a marker layer to the interface. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use a figure-correcting layer having this attribute, in order to prevent undesired optical interference or false measurement signals when obtaining figure measurements. It has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a

matter of obvious design choice. *In re Leshin*, 125 USPQ 416. Regarding the interface marker layer, the technique discussed by Sun is functionally equivalent, in terms of locating via optical processes and assessing the thickness of the thin film located on the substrate and therefore the effective figure of the substrate. It therefore would have been obvious to one having ordinary skill in the art at the time the invention was made to have implemented this technique rather than applying a separate marker layer before applying the slurry layer, since the configuration and procedures taught are functionally equivalent.

8. Claims 9,10, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sun, in view of U.S. Patent No. 5,643,472 to Engelsberg. Sun, or the modified method of Sun, does not expressly disclose the step of locally adjusting the thickness of the figure-correcting layer as being carried out with a beam selected from the group consisting of an electron beam, an ion beam, and an electromagnetic beam. However, it is well known in the art to implement an electromagnetic beam for correcting adjusting the thickness of a figure layer. Figure 1 of Engelsberg shows a means for selective removal of material by irradiation, comprising a radiation source 410, optical lens 450, and a substrate 12 to be adjusted. The device selectively removes "undesired material from a treatment surface of a substrate by irradiating the undesired material with energetic photons having a spatial and temporal concentration (energy and power fluxes) sufficient to remove the undesired material and insufficient to alter the physical properties of the underlying substrate" (Column 3, line 63 – Column 4, line 2). "The radiation source (of energetic photons) may be any means known in the art to provide photons of the requisite energy level...such as a pulsed ultraviolet laser" (Column 4, lines 10-12 and 15). It would have been obvious to one having ordinary skill in the art at the time the invention was

made to have substituted an electromagnetic beam means for the slurry-polishing technique of Sun, in order to precisely alter only the undesired material without harming underlying physical properties of the substrate, and further since this technique is functionally equivalent to the means and method of Sun, in terms of eliminating unwanted elements of the figure layers.

9. Claims 12 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sun, in view of U.S. Patent No. 4,482,424 to Katzir et al. (Katzir). Sun, or the modified method of Sun, does not specifically teach measuring the thickness of the figure-correcting layer by fluorescence (or by an optical method selected from the group consisting of interferometry, optical reflectance spectroscopy, ultrasound reflectance spectroscopy, and fluorescence measurement). However, it is well known in the art to implement fluorescence measuring for such a purpose. Katzir discloses a method for monitoring etching of resists by monitoring the fluorescence of the unetched material, and shows in Figure 2 a substrate covered by an organic material 18, doped with fluorescence, disposed beneath a layer of SiO_2 20 and a photoresist layer 22. "During the reactive ion etching of the SiO_2 layer 20, in the CHF_3 plasma, the intensity of the fluorescence emitted by the planarizing layer 18 remains constant. But as soon as the detected fluorescence is first observed to substantially decrease...the etching of the SiO_2 layer is halted. Thus, over-etching of the SiO_2 layer 20, and undesirable excessive etching of the upper, high resolution resist layer 22, is avoided" (Column 4, lines 55-65). It would have been obvious to one having ordinary skill in the art to have used fluorescence to measure the thickness of the figure-correcting layer (e.g. slurry 50) of Sun. This layer could have been doped with fluorescent material, as could upper layers of th substrate, in order to detect and prevent overstripping of the figure layers.

10. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sun, in view of U.S. Patent No. 5,814,528 to Ju et al (Ju). Sun does not specifically teach measuring the thickness of the figure-correcting layer through the use of ultrasound. However, it is well known in the art to implement ultrasound in the processing and analysis of substrate figures. Figures 1A and 1B of Ju discloses a conventional configuration of bonded semiconductor substrates. "Methods for observing the non-contact regions of the pair of (such) semiconductor substrates include using an IR image (infrared image), using ultrasound microscopy, using x-ray topography and using a magic mirror" (Column 1, lines 24-27). It would have been obvious to one having ordinary skill in the art at the time the invention was made to employ ultrasound in measuring the thickness of the figure-correcting layer of the disclosure of Sun, in order to monitor thickness of the substrate figure layers "simply and easily" (Ju, Column 1, line 34).

11. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sun, in view of U.S. Patent No. 5,640,242 to O'Boyle et al (O'Boyle). Sun shows in Figure 4 a means for measuring the thickness of the figure-correcting layer 50 at a plurality of points simultaneously, comprising a one-dimensional detector array 24a-d. It does not specifically show a two-dimensional detector array employed for this purpose. However, it is well known in the art to implement two-dimensional detector configurations for measuring adjustment of a substrate figure. Figure 2 of O'Boyle shows 512x512 pixel resolution CCD camera 34 implemented to detect and analyze reflected light intensity and interference from a substrate 20 to be measured. It would have been obvious to one having ordinary skill in the art at the time the invention was made to substitute such a CCD camera (two-dimensional array detector) for the single-dimension detector 24a-d of Sun, in order to more effectively detect reflected and interfering light from

layers of the substrate to be corrected, since two-dimensional configurations allow for more spatial coverage of a plurality of imaged points.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

U.S. Patent No. 6,037,270 to Kageyama et al. discloses a method of processing and analyzing a substrate which comprises fluorescent surface analysis (see Column 2, lines 38-58 and Column 11, line 50 – Column 12, line 11).

U.S. Patent No. 6,261,152 to Aiyer shows in Figure 1 a heterodyne interferometry thickness monitoring system comprising a wafer 110 to be monitored (including planarization film 112 and substrate 148), via a laser source 118, photodetector 134, and a reference photodetector 138. The application of a figure-correcting layer and use of polishing tools is also discussed (see Column 1, lines 34-43).

U.S. Patent No. 6,111,634 to Pecen et al. describes conventional CMP techniques comprising figure-correcting layers used in conjunction with polishing tools and laser interferometry (see Column 2, lines 42-62), and discloses a CMP method and apparatus for monitoring and adjusting thickness of figure-correcting film layers (see Column 3, lines 60-67 and Column 4, lines 1-5 and 18-34).

U.S. Patent No. 6,004,047 to Akimoto et al. discloses a method and apparatus for processing and evaluating photoresist. Figure 17 shows a flow-chart procedure for measuring film thickness (801) of a specimen, and correcting the value of film thickness (803).

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christopher W. Glass whose telephone number is 703-305-1980. The examiner can normally be reached 9:00am-5:00pm, M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frank Font can be reached at 703-308-4881. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

cg
July 10, 2002

STEPHONE ALLEN
PRIMARY EXAMINER